SKYTRON

SURGICAL TABLE
MAINTENANCE MANUAL

MODEL 1700

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WARNING
Indicates a possibility of personal injury.

NOTE
Indicates important facts or helpful hints.

CAUTION
Indicates a possibility of damage to equipment.

Although current at time of publication, SKYTRON's policy of continuous development makes this manual subject to change without notice.

BASIC RECOMMENDED TOOLS:

1/8". 1/4" STRAIGHT BLADE SCREWDRIVERS
#2 PHILLIPS SCREWDRIVER
HYDRAULIC PRESSURE GAUGE SKYTRON P.N. 6-050-02
METRIC ALLEN® WRENCHES 1.5mm-8mm
ADJUSTABLE CRESCENT WRENCH
DIGITAL VOLTMETER, TRUE RMS
METRIC OPEN END WRENCHES 7mm-18mm

BASIC RECOMMENDED MAINTENANCE PROCEDURES

The basic items notes below should be inspected at a minimal interval period of 6 months (dependant on usage). For optimal usage, safety and longevity of the product, have it serviced only by an authorized Skytron representative with authentic Skytron replacement parts.

- Check Power Cord (if applicable)
- Check Pendant Control (if applicable)
- Check Oil Level in Reservoir
- Check For Hydraulic Leaks
- Check Pressure Relief Valve Setting
- Check All Table Functions
- Check Side Rails
- Check Velcro
- Lubricate Elevation Slider Assembly with SKYTRON Slider Grease P/N D6-010-89
- Tighten X-Ray Top Stand-Offs, Use Loc-tite
- Lubricate Castors
- Check brake pads for wear and inspect brake cylinders for proper operation.

Only facility-authorized SKYTRON trained, maintenance personnel should troubleshoot the SKYTRON Surgical Table. Trouble shooting by unauthorized personnel could result in personal injury or equipment damage.

How to contact us:
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FAX: 616-957-5053

EQUIPMENT LABELS AND SPECIFICATIONS

INDICATES DANGEROUS VOLTAGE, 120 V, 60 Hz

CLASS I DEFIBRILLATION PROOF, TYPE B EQUIPMENT- IPX4 RATED.
INTERNALLY POWERED EQUIPMENT

PROTECTIVE GROUNDING.
IN ORDER TO ENSURE PROPER GROUNDING RELIABILITY,
THIS TABLE MUST BE CONNECTED TO A PROPERLY GROUNDED
HOSPITAL GRADE OUTLET.

CONNECTION FOR NEUTRAL CONDUCTOR SUPPLIED

UNIT TO BE USED ONLY IN SPECIFIED ENVIRONMENTAL CONDITIONS
TEMPERATURE: 15˚ - 30˚ C (60˚ -85˚ F)
HUMIDITY: 30% - 60% RELATIVE HUMIDITY, NON CONDENSING

AC VOLTAGE

FUSE (2) 10 AMP FAST ACTING

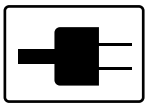
IPX4 ENCLOSURE CLASS

V VOLTAGE RATING OF THE UNIT

A AMPERAGE RATING OF THE UNIT

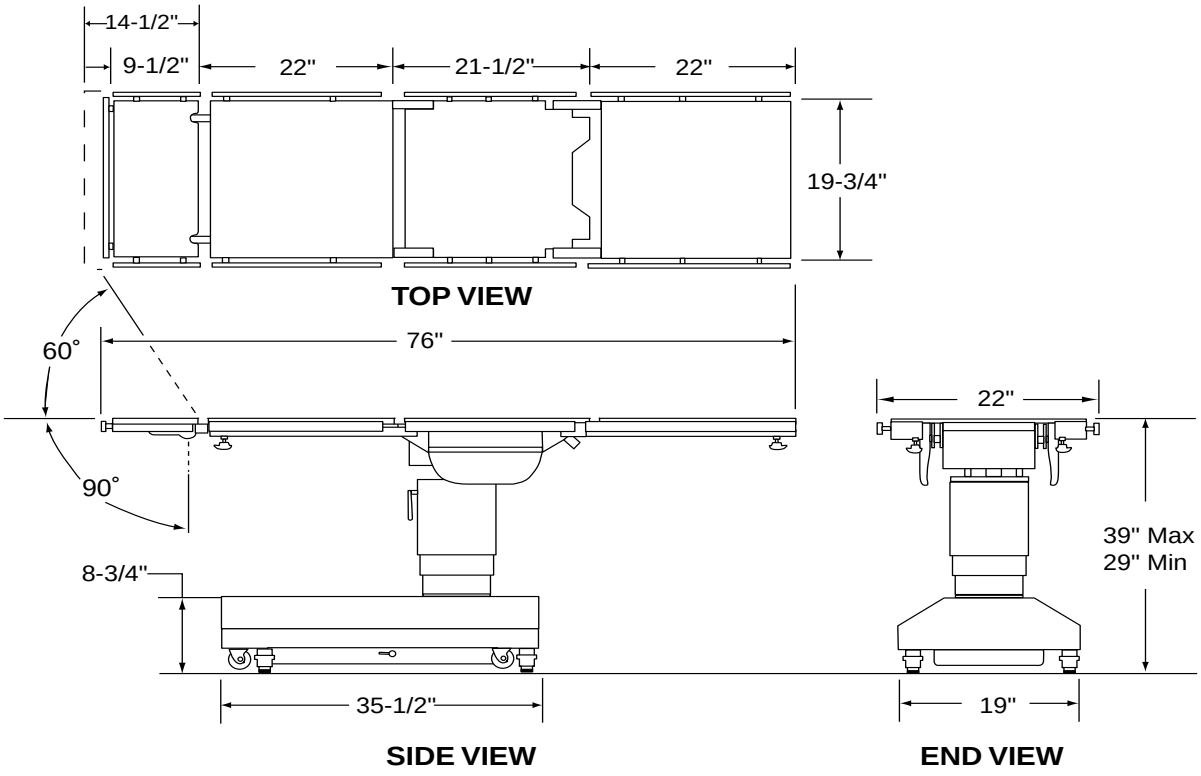
HZ FREQUENCY OF THE UNIT

ATTENTION, CONSULT MANUAL FOR FURTHER INSTRUCTIONS.
INDICATES SPECIAL USER ATTENTION.



POWERED BY AC VOLTAGE

1700 Series General Purpose Surgical Table Specifications



Electrical Specifications

Power requirements	120 VAC, 60Hz, 300 Watts
Current Leakage	Less than 100 micro amps
Power Cord	15 feet w/hospital grade connector(removeable)

ENTELA CERTIFIED
TO UL2601-1
CAN/CSA601.1, IEC 60601-2-46

US C entela® Certified

1-1. General

Electro-Hydraulic System

The hydraulic system (with the exception of the hydraulic cylinders and hoses) is contained within the base of the table. The hydraulic valves and pump are electrically controlled by the use of a hand-held push button pendant control. The power requirements for the table are 120 VAC, 5 amp, 60 Hz.

The table contains the following components. Refer to the block diagram (figure 1-1) for relationship.

a. Oil Reservoir - Main oil supply. Approximately two quarts.

b. Motor/Pump Assembly - A positive displacement gear type pump provides the necessary oil pressure and volume.

c. Pressure Relief Valve - Provides an alternate oil path when the hydraulic cylinders reach the end of their stroke.

d. Electro/Hydraulic Mini-Valve Assemblies -These direct the fluid to the appropriate hydraulic cylinders.

e. Hydraulic Lines, Fittings, Connections - They provide a path for the hydraulic oil.

f. Hydraulic Cylinders - They convert the hydraulic fluid pressure and volume into mechanical motion.

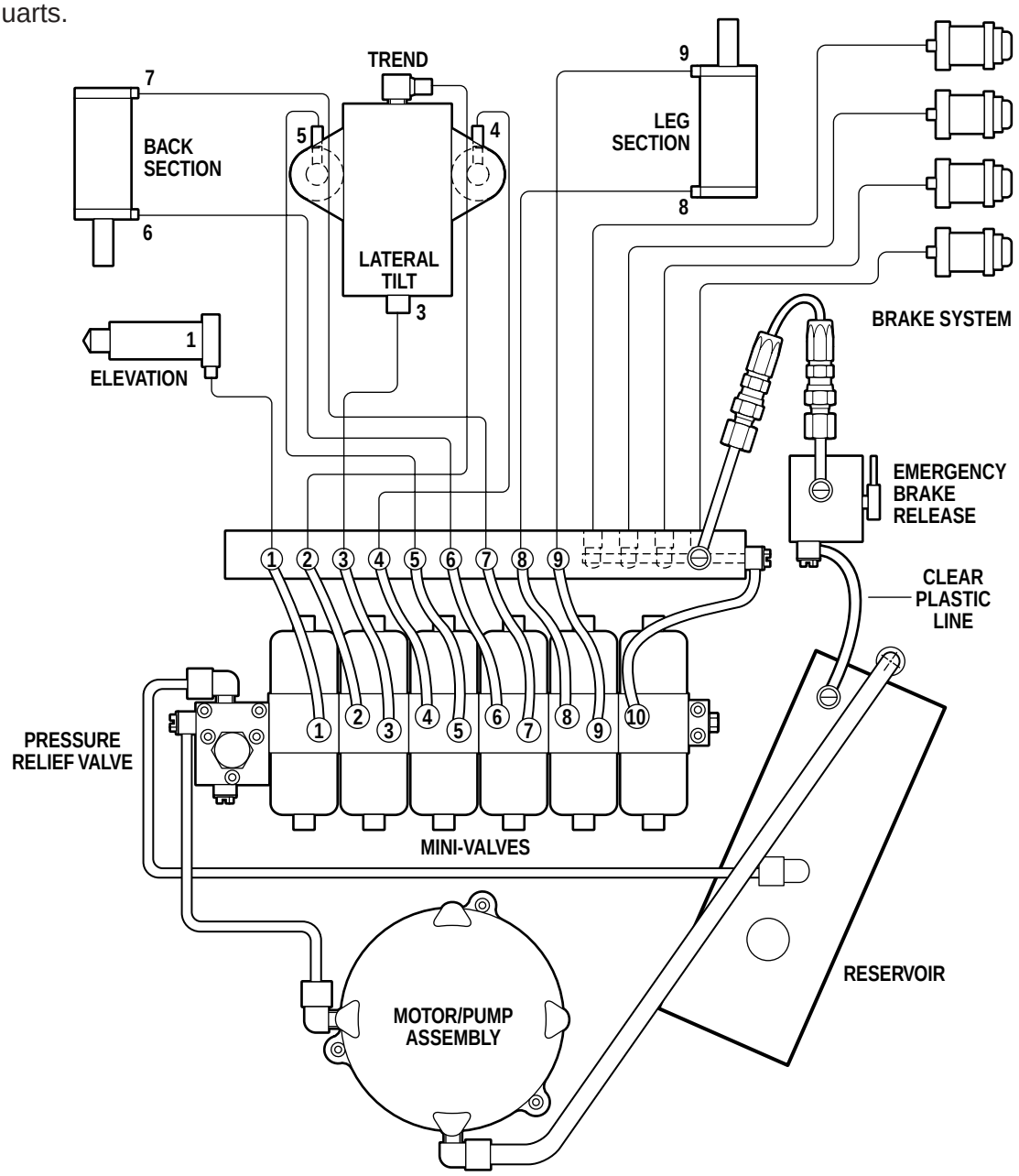


Figure 1-1. Hydraulic Block Diagram

1-2. Component Operation

a. Motor/Pump Operation

The motor/pump assembly is a positive displacement gear type pump that provides the oil pressure and volume for the entire hydraulic system. The pump has an inlet side and an outlet side. The inlet side is connected to the reservoir which provides the oil supply.

The output line of the pump is connected to the main oil galley which is internal and common to all the hydraulic mini-valves and pressure relief valve. Also, common to the hydraulic mini-valves and pressure relief valve is an oil galley that internally connects to the oil reservoir to provide a return path for the hydraulic oil. See figure 1-2.

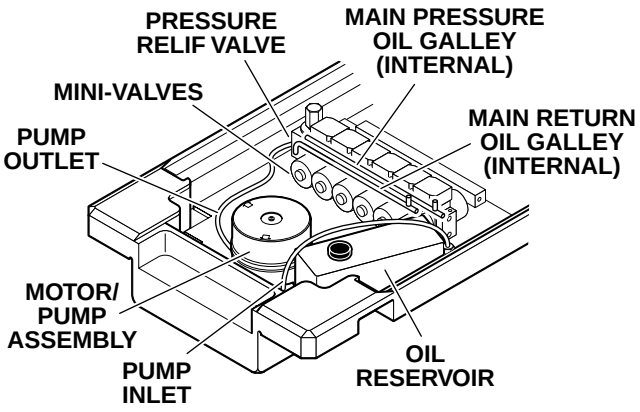


Figure 1-2.

b. Pressure Relief Valve

This device provides an alternate oil path when the hydraulic cylinders reach the end of their stroke and the pump continues to run. If this path were not provided, the pump motor would stall because the oil cannot be compressed. The pressure relief valve is directly connected to the mini-valve bodies and shares both the common internal main pressure oil galley, and the return oil galley, that internally connect to the reservoir. See figure 1-3.

The main component of the valve is an adjustable spring loaded plunger that is pushed off from its seat by the oil pressure. The oil then flows back into the reservoir. See figure 1-4. Turning the adjustment nut clockwise increases the amount of oil pressure required to open the valve, and turning it counterclockwise decreases the amount of oil pressure. (See adjustment section for specification.)

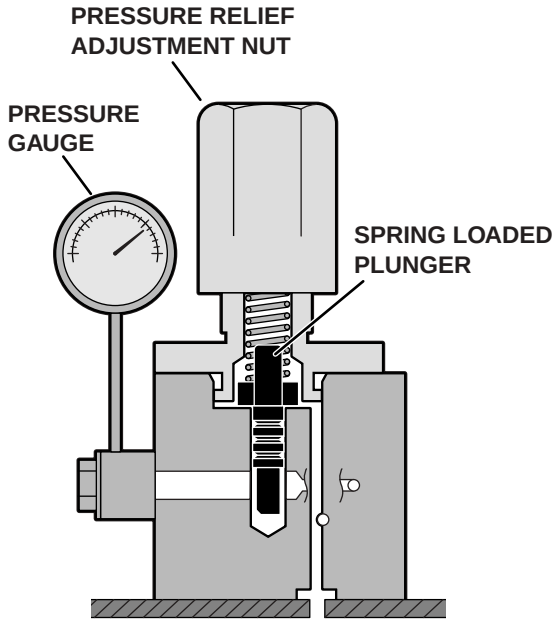


Figure 1-3. Pressure Relief Valve Not Functioning

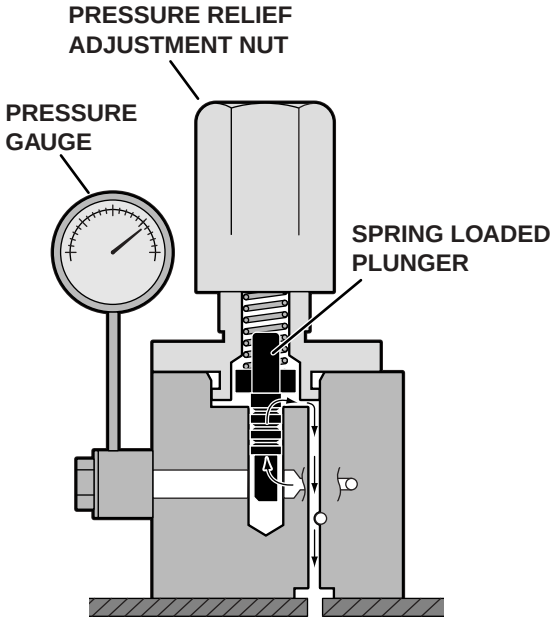


Figure 1-4. Pressure Relief Valve Functioning

c. Mini-Valves

The operation of the mini-valves is identical for all table functions except the elevation and brake circuits. These two hydraulic circuits use a 3-way (single check valve) type mini-valve. All other functions use a 4-way (dual check valve) type mini-valve.

Either type mini-valve is controlled by two pushing type, electrically operated solenoids. The solenoids push the spool valve (located in the lower portion of the valve) one way or the other. This motion opens the main supply galley (which has pump pressure) allowing the oil to flow through the various parts of the mini-valve to the function. The spool valve also opens an oil return circuit which allows the oil to return to the oil reservoir.

The main components of the mini-valve and their functions are listed below:

1. Spool Valve - Opens the main oil galley (pump pressure) to either mini-valve outlet depending on which direction the spool valve is pushed. Also it provides a return path for the oil returning back into the reservoir.

2. Pilot Plunger - There are two plungers in a four-way mini-valve (one in a 3-way mini-valve), one under each check valve. The purpose of the pilot plungers is to mechanically open the return check valve allowing the oil to return back into the reservoir.

3. Check Valve - Two are provided in each four-way mini-valve to seal the oil in the cylinders and oil lines and prevent any movement of the table. One check valve is provided in a 3-way mini-valve.

4. Speed Adjustments - There are two speed adjustments in each mini-valve. They are needle valve type controls which restrict the volume of oil returning back into the reservoir, thereby controlling the speed of the table surface movement. A 3-way mini-valve has only one speed adjustment.

The speed controls are always located in the return oil circuit. This prevents uncontrolled movement of the piston in the slave cylinder due to one side of the piston being loaded with hydraulic pressure and the other side having no load.

Also, by using this control method, it doesn't matter what size cylinder and piston is used because the speed can be controlled by restricting the return oil. If the pump puts out more volume to a certain slave cylinder than the speed control is allowing to go back to the reservoir, the pressure relief valve provides an alternate path for the pump oil.

d. Mini-Valve in Neutral Position

(No fluid flow) See figure 1-5.

1. Spool Valve Centered - This closes off both oil pressure and oil return galleys.

2. Pilot Plungers Both Closed -The pilot plungers control the opening of the check valves. If they are closed, the check valves must be closed.

3. Check Valves - Both check valves are closed trapping the oil in the cylinder and oil lines.

4. Speed Adjustment - When the mini-valve is in the neutral position, the speed adjustment does not affect anything because there is not any oil flow.

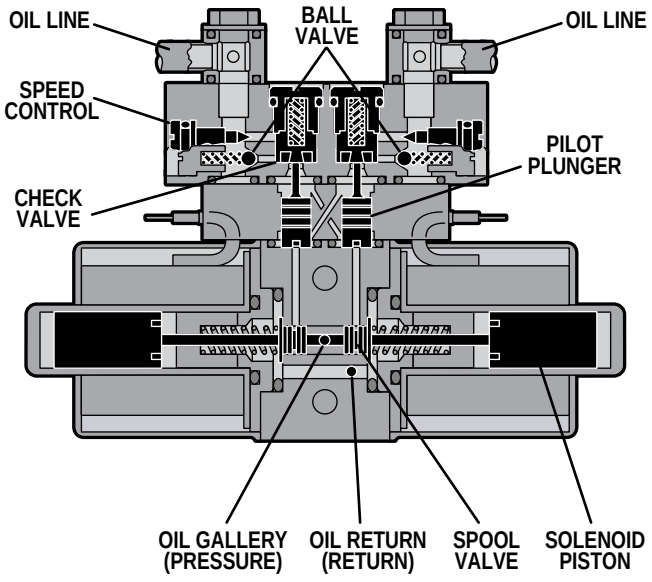


Figure 1-5. Mini-Valve in Neutral Position

e. Mini-Valve Right Port Activated
(See figure 1-6)
Slave Cylinder Piston Moves to Left
Right Mini-Valve Port is Supply Line
Left Mini-Valve Port is Return Line

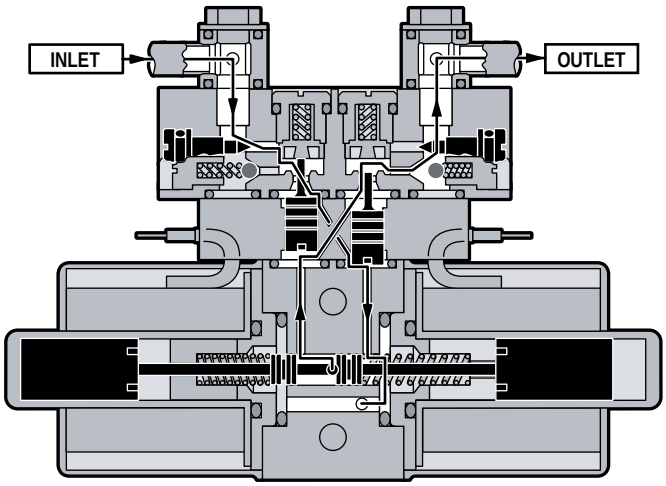


Figure 1-6. Mini-Valve Right Port Activated

1. Spool Valve - Pushed to the left by electric solenoid. This opens the internal oil pressure galley allowing the fluid to go through the check valve and on to the cylinder. Also, the spool valve opens the oil return line providing an oil path through the internal oil galley back to the reservoir.

2. Pilot Plunger Valve - Left pilot plunger valve is pushed up by the incoming oil pressure mechanically opening the check valve located above it in the return circuit. This action allows the oil from the left side of the slave cylinder to go back into the reservoir. The right pilot plunger valve is not affected in this operation mode.

3. Check Valves - Both check valves are opened in this operation mode. The right check valve is pushed open by the oil pressure created by the pump. The oil then continues to go through the lines and pushes the slave cylinder piston to the left. At the same time, the left check valve is held open mechanically by the pilot plunger providing a return path for the oil through the mini-valve back to the reservoir.

4. Speed Adjustment - The right speed control (output side) does not have any effect in this operation mode because the oil is routed around the speed adjustment through a by-pass valve and then to the output port. The left speed adjustment controls the speed of the table function by restricting the amount of oil going back into the reservoir.

f. Mini-Valve Left Port Activated
(See figure 1-7.)
Slave Cylinder Piston Moves to Right
Left Mini-Valve Port is Supply Line
Right Mini-Valve Port is Return Line

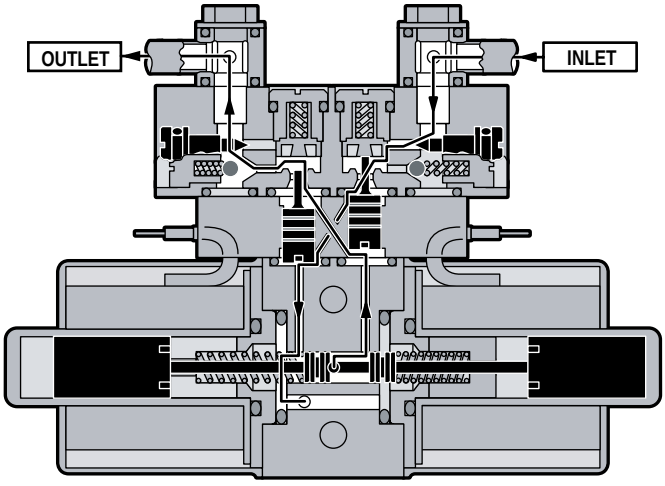


Figure 1-7. Mini-Valve Left Port Activated

1. Spool Valve -Pushed to the right by electric solenoid. This opens the internal oil pressure galley allowing the fluid to go through the check valve and on to the cylinder. Also, the spool valve opens the oil return line providing an oil path through the internal oil galley back to the reservoir.

2. Pilot Plunger Valve - Right pilot plunger valve is pushed up by the incoming oil pressure mechanically opening the check valve located above it in the return circuit. This action allows the oil from the right side of the slave cylinder to go back into the reservoir. The left pilot plunger valve is not affected in this operation mode.

3. Check Valves - Both check valves are opened in this operation mode. The left valve is pushed open by the oil pressure created by the pump. The oil then continues to go through the lines and pushes the slave cylinder piston to the right. At the same time, the right check valve is held open mechanically by the pilot plunger providing a return path for the oil through the mini-valve back to the reservoir.

4. Speed Adjustment - The left speed control (output side) does not have any effect in this operation mode because the oil is routed around the speed adjustment through a by-pass valve and then to the output port. The right speed adjustment controls the speed of the table function by restricting the amount of oil going back to the reservoir.

g. Hydraulic Cylinders (Slave Cylinders)

There are several different types of hydraulic cylinders used in the table that activate the control functions, all operate basically the same way. The control functions are listed below: (See figure 1-8.).

Back Section--1, double action cylinder
Leg Section--1, double action cylinder
Trendelenburg--2, single action cylinders functioning together to act as 1 dual action cylinder
Lateral Tilt--2, single action cylinders functioning together to act as 1 dual action cylinder
Elevation--1, single action cylinder
Brakes--4, single action cylinders

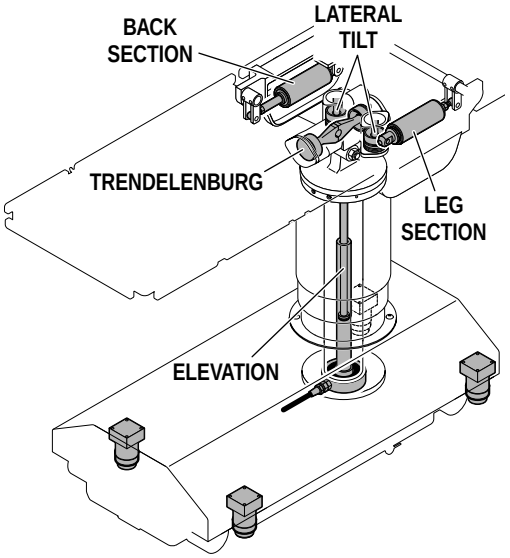


Figure 1-8. Cylinder Placement

1. Back Section and Leg Section Cylinders - The double action cylinders are closed at one end and have a movable piston with hydraulic fluid on both sides. Connected to this piston is a ram that exits out of the other end of the cylinder. Through the use of a clevis and pin arrangement, this ram is connected to a movable table surface.

The movable surface can be moved one way or the other by pumping hydraulic fluid into the cylinder on either side of the piston. A return path is opened for the oil on the other side. See figure 1-9.

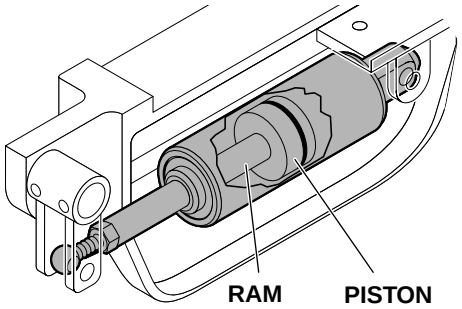


Figure 1-9. Back Section Cylinder

2. Trendelenburg Cylinder Assembly - The Trendelenburg and Lateral Tilt cylinders share a common housing. The Trendelenburg assembly consists of two pistons and connecting rods that connect to a stationary pin on the Trendelenburg pivot casting which is attached to the center column. The cylinder housing is attached to the table top and connects to the pivot casting with an axis pin. When hydraulic fluid is pumped into one cylinder, the cylinder housing itself moves around the pivot housing causing the table top to tilt. A return path is opened for the hydraulic fluid of the other piston. See figure 1-10.

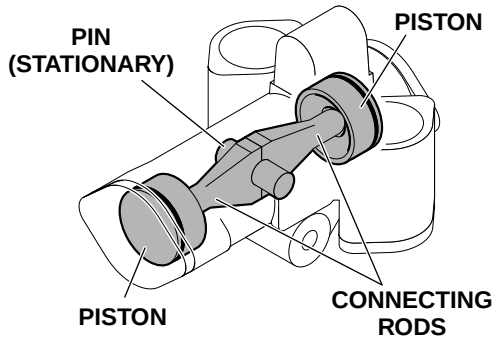


Figure 1-10. Trendelenburg Cylinder Assy.

3. Lateral Tilt Assembly - The lateral tilt assembly consists of two pistons and connecting rods. The connecting rods attach to the table top frame.
When hydraulic fluid is pumped into one cylinder, the piston and connecting rod tilts the table top to one side. To tilt the table top in the opposite direction, fluid is pumped into the opposite cylinder. See figure 1-11.

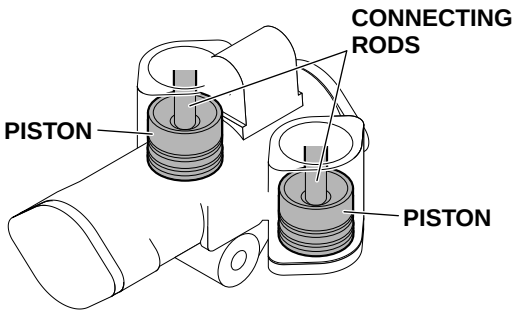


Figure 1-11. Lateral Tilt Cylinder Assembly

4. Elevation Cylinder - This single action cylinder does not have hydraulic fluid on both sides of the piston. It depends on the weight of the table top assembly to lower it.
The cylinder is set in the center of the elevation main column. The cylinder is elevated by the driven force of the oil pressure. When lowering, the oil that is accumulated in the cylinder is returned to the oil reservoir through the mini-valve due to the table top weight.
A slider support assembly is used to support the weight of the upper table section. A stainless steel shroud covers the flexible hydraulic hoses and slider. See figure 1-12.

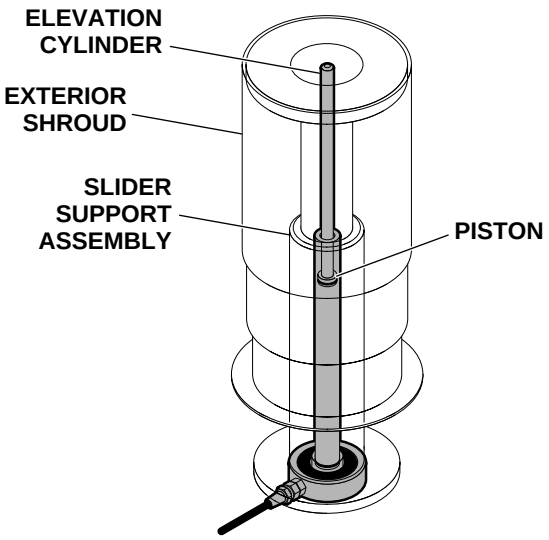


Figure 1-12. Elevation Cylinder Assembly

5. Brake Cylinders - The brake cylinders are single action type similar to the elevation cylinder. The movable piston's ram is connected to a brake pad. See figure 1-13. Oil pumped into the top of the cylinder pushes the piston down raising the table base off its casters. An internal return spring on the bottom of the piston, pushes the piston up to return the oil through the mini-valve to the reservoir.

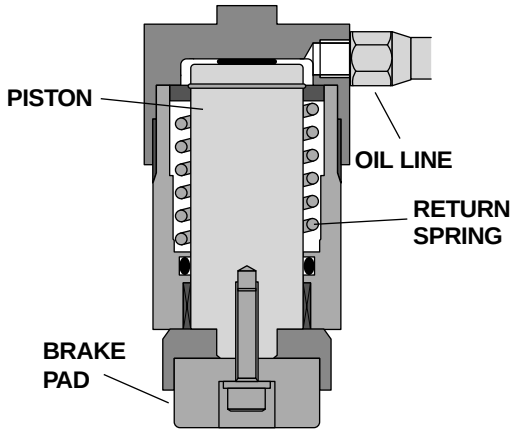


Figure 1-13. Single Action Brake Cylinder

h. Elevation Cylinder Return Circuit

Three-way (single check valve type) mini-valves control both the elevation and return circuits. The elevation circuit operation within the mini-valve is identical to the operation of the four-way valves previously described. In the return position, inlet pressure pushes the pilot plunger up and opens the return check valve. See figure 1-14. The open check valve allows a path for the oil in the elevation cylinder to return to the reservoir. When the pilot plunger valve is opened, the continuing pump pressure opens the pressure relief valve which provides a return oil path to the reservoir.

The mini-valve contains only one check valve which is used to trap the oil in the elevation cylinder thereby supporting the table top. When the top is lowered the check valve is mechanically held open by the pilot plunger through pump pressure.

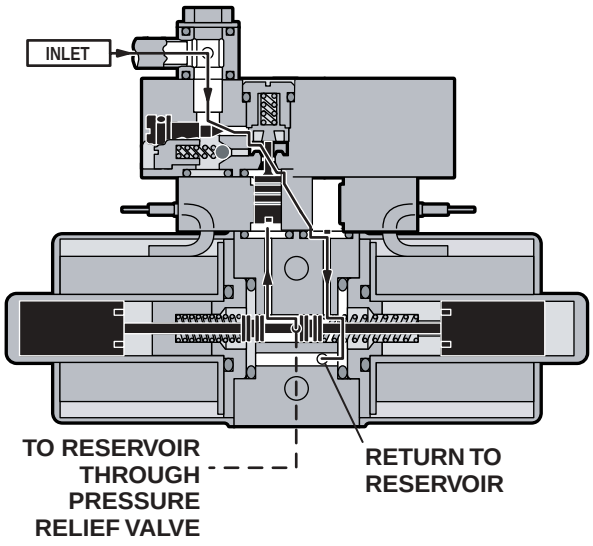


Figure 1-14. Elevation Return Circuit

i. Brake System

The brake system consists of the following components: (figure 1-15)

1. Single action slave cylinders (4 each).
2. 3-way (single check valve type) mini-valve.
3. Manually controlled emergency brake release.
4. Plumbing terminal, flexible hoses, copper lines and "O" rings.
5. Portions of the electrical system.

Each corner of the cast-iron table base has a hydraulic brake cylinder. These single action cylinders are hydraulically connected in parallel to the mini-valve and all four are activated together. It is normal for one corner of the table to raise before the others due to the weight distribution of the table.

An electronic timer in the relay box is activated when any function on the pendant control is pushed momentarily. The pump/motor and brake system mini-valve are activated and the brake cylinders are completely set. The electronic timer runs for approx. 8-10 seconds.

The brakes are released by pushing the BRAKE UNLOCK button momentarily. An electronic timer in the relay box activates the brake function hydraulic mini-valve and pump/motor.

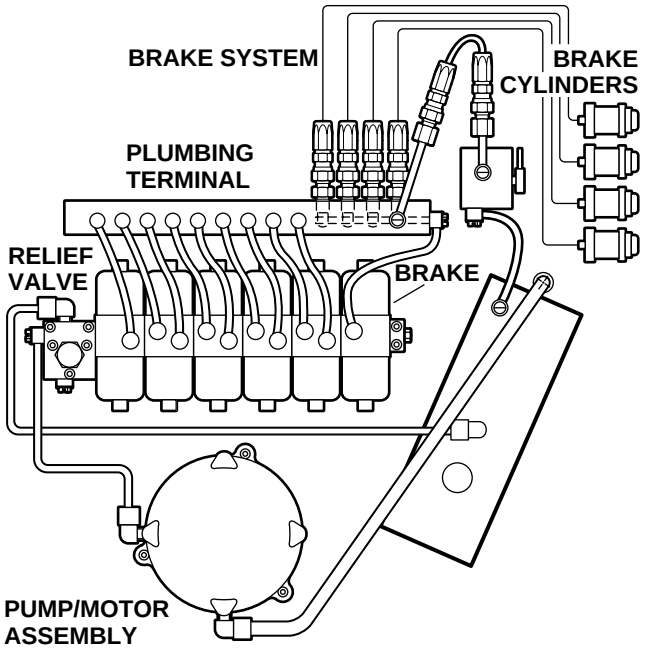


Figure 1-15. Brake System Block Diagram

When activated, the return hydraulic circuit operates similar to the elevation cylinder return circuit. Return springs inside the single action brake cylinders retract the brake pads and provide the pressure to return the hydraulic oil back to the reservoir. The electronic timer operates the return circuit for approximately 8-10 seconds.

j. Emergency Brake Release

The emergency brake release is simply a manually operated bypass valve connected in parallel to the brake cylinders and the oil reservoir. See figure 1-16. When the valve is opened (turned counterclockwise) a return circuit for the brake hydraulic fluid is opened. The return springs force the pistons up pushing the hydraulic oil back into the reservoir and retracting the brake pads.

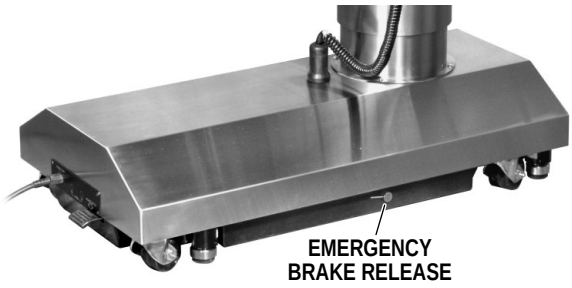


Figure 1-16.

NOTE

•The emergency brake release valve must be tightened securely when not in use.

•If the emergency brake release valve has been operated, the UNLOCK button on the pendant control may have to be pressed before brakes will lock again.

If the emergency brake release valve is open or loose, the brakes will release slowly- depending on how loose the valve is, this could take anywhere from a few minutes to several hours.

1-3. Hydraulic Adjustments

a. Fluid Level.

The fluid level should be approximately 1/2" below the filler hole or gasket surface. If additional fluid is needed, remove the filler vent cap with a phillips screwdriver and add fluid through this opening using a funnel. See figure 1-17.

NOTE

The elevation cylinder should be completely down and all the other control functions in their neutral position when checking oil level.

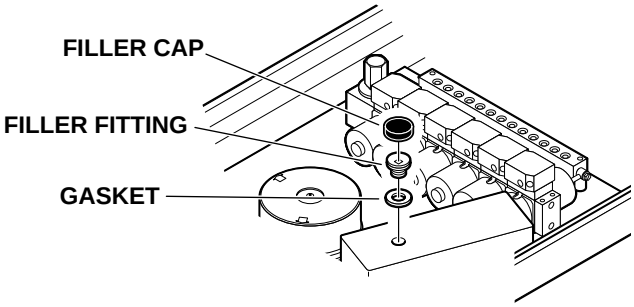


Figure 1-17.

The type of oil that should be used is Mobil DTE #25 or equivalent. This is a very high quality hydraulic oil. The table requires approximately two quarts of oil to operate properly.

b. Bleeding The Hydraulic System

To purge the air from the hydraulic system, operate each function back and forth at least two or three times.

NOTE

Whenever a hydraulic line or component is replaced, bleed the air out of the lines using the pump pressure before making the final connection. Then operate the function until it stalls in both directions.

c. Pressure Relief Valve

The pressure relief valve is adjusted by turning the adjustment nut until the desired pressure is reached.

To adjust:

1. Remove the blind cap and attach a hydraulic pressure gauge to the main oil galley using a 6mm plumbing bolt. See figure 1-18.

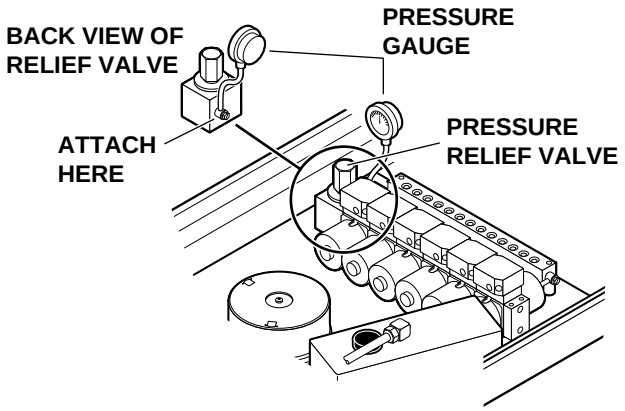


Figure 1-18.

2. Raise the table top until the piston reaches the end of its stroke and stalls. Observe reading on pressure gauge and turn the adjustment nut (clockwise to increase oil pressure, counterclockwise to decrease) until desired reading is obtained. Pressure should be 80KG/CM† -1138 PSI.

d. Speed Controls

The speed controls restrict the volume of oil returning back to the reservoir thereby controlling the speed of each control function.

All four-way mini-valves, have two speed controls located in the ends of each valve body. All three-way mini-valves have only one speed control.

One speed control adjusts one direction of a particular function and the opposite speed control adjusts the other direction. They are adjustable by using a small straight blade screwdriver and turning the adjustment screw clockwise to decrease the speed and counterclockwise to increase the speed. Refer to figure 1-19.

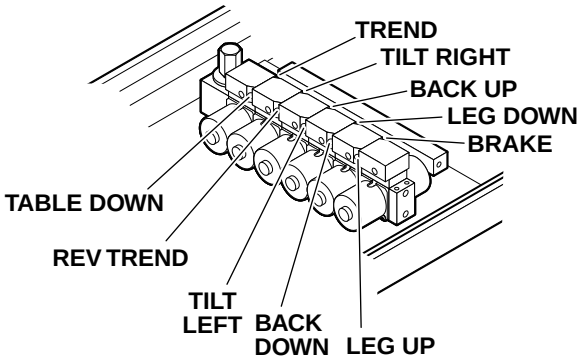


Figure 1-19.

Any control function should move in either direction at the same rate. If the rate of a certain function is too slow, open the speed control slightly and recheck. Use the second hand on a watch and time a particular function. Match that time in the opposite direction by opening or closing the speed control. Approximate operating times are as follows:

Lateral Tilt	5 seconds
Back Up	13 seconds
Back Down	5 seconds

A pressure gauge should be used to set the speed of the back section and Trendelenburg control functions.

To adjust:

1. Attach the pressure gauge onto the main oil galley as shown in figure 1-19.

2. The gauge should read the following values when operating the various control functions in either direction. Turn the speed controls until desired values are obtained.

Back Section	Up	70KG/CM†-995PSI
	Dn	70KG/CM†-995PSI
Trendelenburg	Up	70KG/CM†-995PSI
	Dn	70KG/CM†-995PSI

Elevation - There is not a speed adjustment for raising the table. The speed control will only affect the rate of descent and it should equal the rate of elevation.

SECTION II HYDRAULIC TROUBLESHOOTING

2-1. Precautions

Before attempting to troubleshoot any hydraulic problem on the table, please read through the precautions and notes below.

CAUTION

When disconnecting any of the hydraulic lines, fittings, joints, hoses, etc., for the following control functions, be sure these table surfaces are in their down position or completely supported.

- •Elevation
- •Back Section
- •Leg Section

When working on the Trendelenburg or lateral tilt hydraulic circuits, be sure to support the table top. When working on the brake system make sure the brakes are completely retracted.

WARNING

Failure to follow these precautions may result in an uncontrolled oil spray and damage to the table or personal injury.

2-2. Troubleshooting Notes

When troubleshooting a table malfunction, first determine the following:

1. Does the problem affect all control functions?

2. Does the problem affect only one control function?

3. If the problem affects one control function is it in both directions?

4. Is the problem intermittent?

5. Is the problem no movement of a table surface or does the table surface lose position?

Once the problem has been determined, concentrate on that particular hydraulic circuit or control function.

Listed below are the hydraulic components that are common with all hydraulic circuits. If there is a problem with any of them, it could affect all control functions.

1. Motor/Pump Assembly
2. Reservoir
3. Pressure Relief Valve
4. Certain Oil Lines and Galleys

If there was a problem in the following components, only one control function would normally be affected.

1. Mini-Valve
2. Slave Cylinder
3. Oil Lines

NOTE

Whenever a hydraulic line or component is replaced, bleed the air out of the lines using the pump pressure before making the final connection. After all connections are tight, cycle the control function back and forth two or three times to purge the remaining air from the system.

CAUTION

When installing new "O" rings use white lithium grease or hydraulic oil to thoroughly lubricate the "O" rings and cylinder. Keep everything clean.

Each complete oil circuit is shown on the following pages. When troubleshooting a particular function, refer to the appropriate oil circuit diagram and the list of possible problems

2-3. ELEVATION DIAGNOSIS CHART

Problem	Reason
Table will not elevate properly	Pressure Relief Valve Not Set Properly
	Low on Oil
	Spool Valve Not Centered
	Defective Pump
	Defective Mini-Valve
	Defective Solenoid or Wiring
	Defective Relay Box or Pendant Control
Table will not descend properly	Incorrect Speed Adjustment
	Bad Check Valve
	Spool Valve Not Centered
	Galled Slider Assembly
	Defective Solenoid or Wiring
	Defective Relay Box or Pendant Control
Table loses elevation	Bad Check Valve
	Leaking Mini-Valve
	Loose Fittings, Joints, Hoses
	Leaking "O" Ring Inside Cylinder

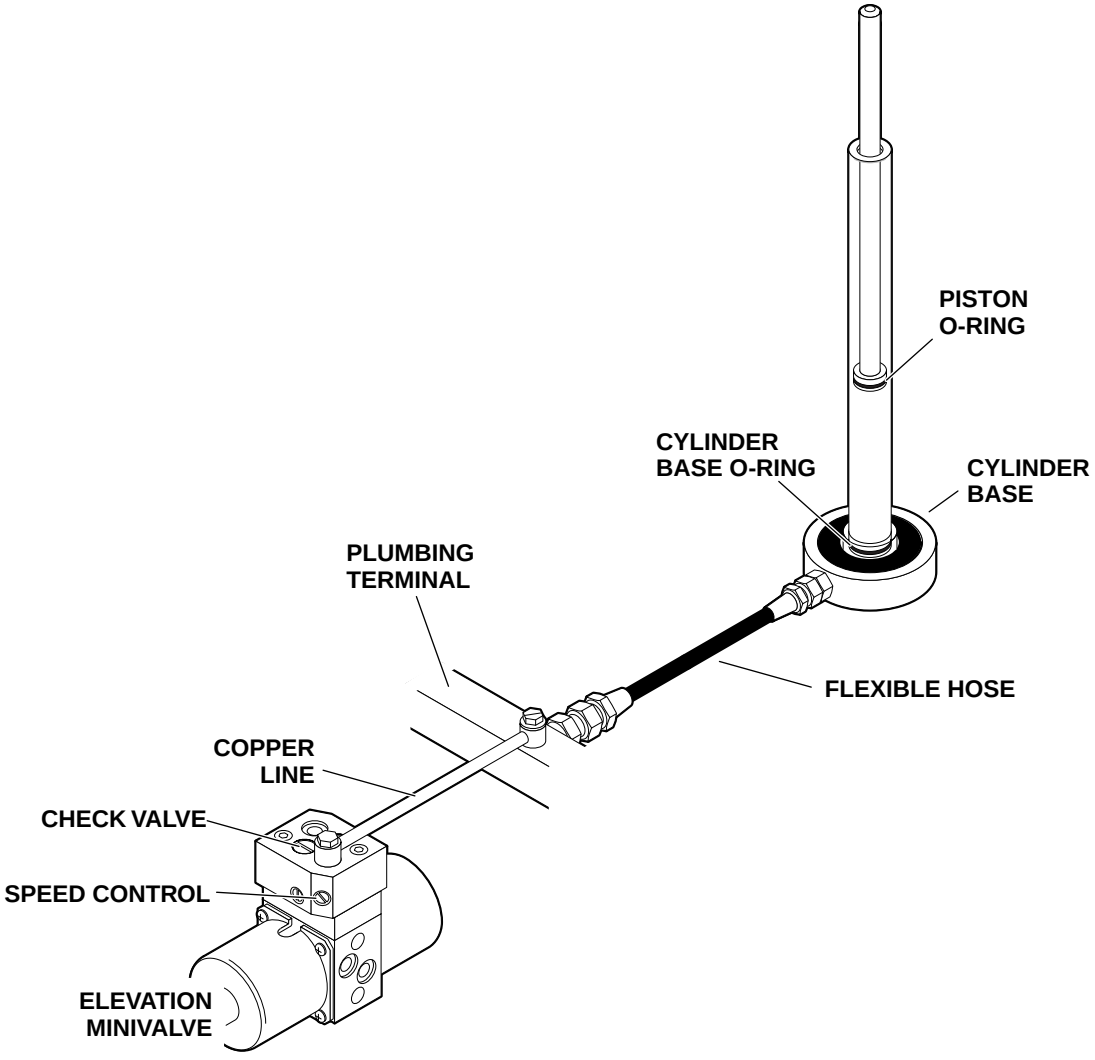


Figure 2-1. Elevation Circuit

2-4. TRENDELENBURG DIAGNOSIS CHART

Problem	Reason
Trendelenburg function moves improperly	Incorrect Speed Adjustment
	Spool Valve Not Centered
	Bad Check Valves
	Low on Oil
	Pinched Hose
	Defective Mini-Valve
	Pressure Relief Valve Not Set Properly
	Bad Solenoid or Wiring
	Defective Relay Box or Pendant Control
Trendelenburg function chatters or loses position	Defective or Dirty Check Valve
	Oil Leakage in Circuit
	Air Inside Cylinder
	Pinched Hose
	Low on Oil

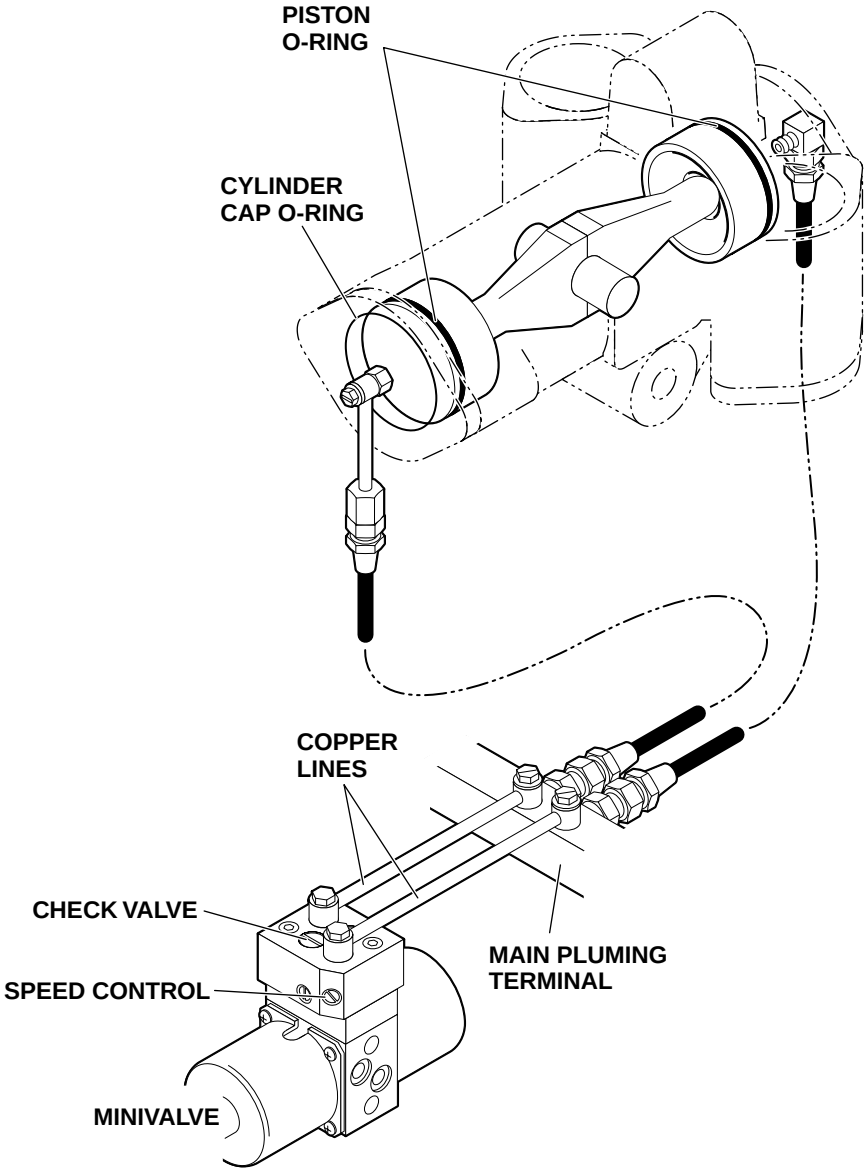


Figure 2-2. Trendelenburg Circuit

2-5. LATERAL TILT DIAGNOSIS CHART

Problem	Reason
Lateral tilt function moves improperly	Incorrect Speed Adjustment
	Spool Valve Not Centered
	Bad Check Valves
	Low on Oil
	Pinched Hose
	Defective Mini-Valve
	Pressure Relief Valve Not Set Properly
	Bad Solenoid
	Defective Relay Box or Pendant Control
Lateral tilt function chatters or loses position	Defective or Dirty Check Valves
	Oil Leakage in Circuit
	Air Inside Cylinder
	Pinched Hose
	Low on Oil

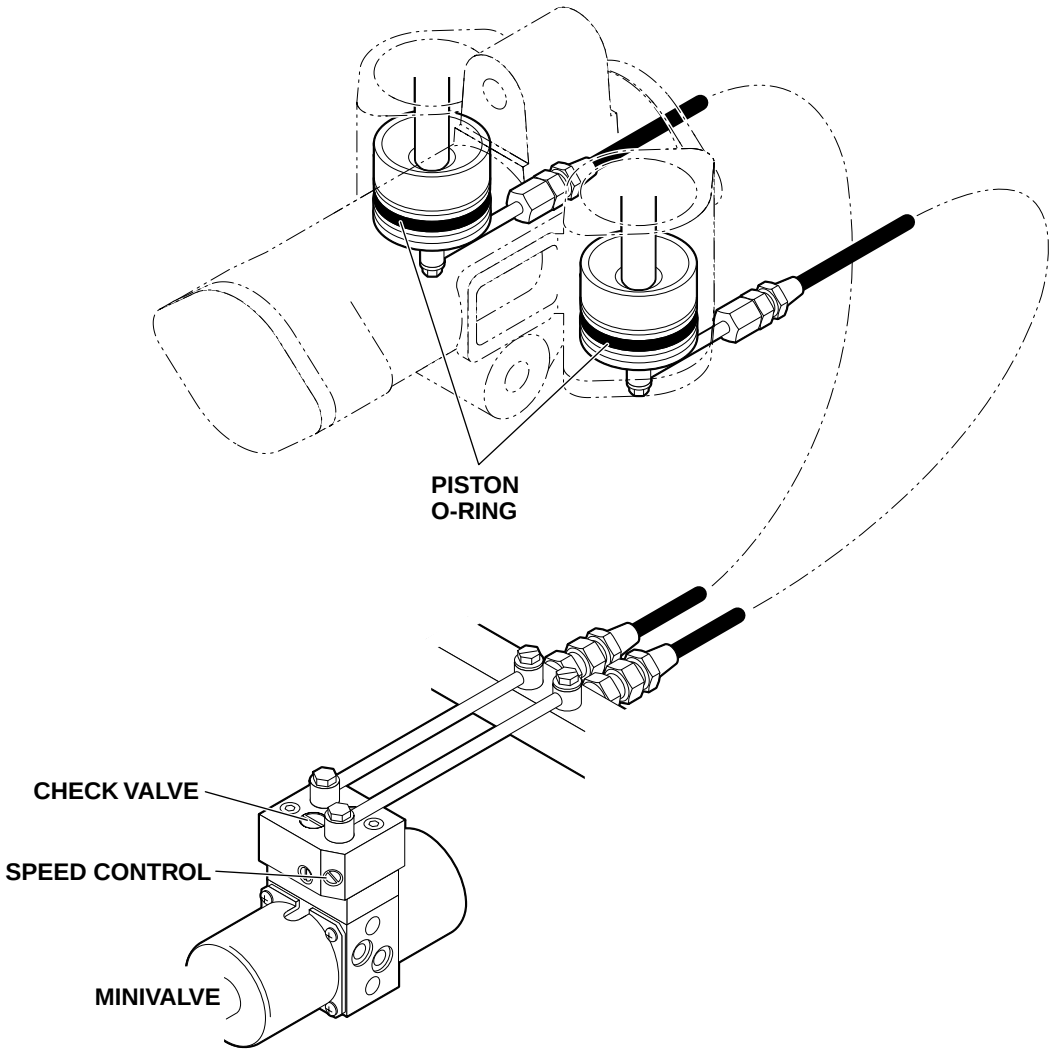


Figure 2-3. Lateral Tilt Circuit

2-6. BACK SECTION DIAGNOSIS CHART

Problem	Reason
Back Section function moves improperly	Incorrect Speed Adjustment
	Spool Valve Not Centered
	Bad Check Valves
	Low on Oil
	Pinched Hose
	Defective Mini-Valve
	Pressure Relief Valve Not Set Properly
	Bad Solenoid
	Defective Relay Box or Pendant Control
Back Section function chatters or loses position	Defective or Dirty Check Valves
	Oil Leakage in Circuit
	Air Inside Cylinder
	Pinched Hose
	Low on Oil

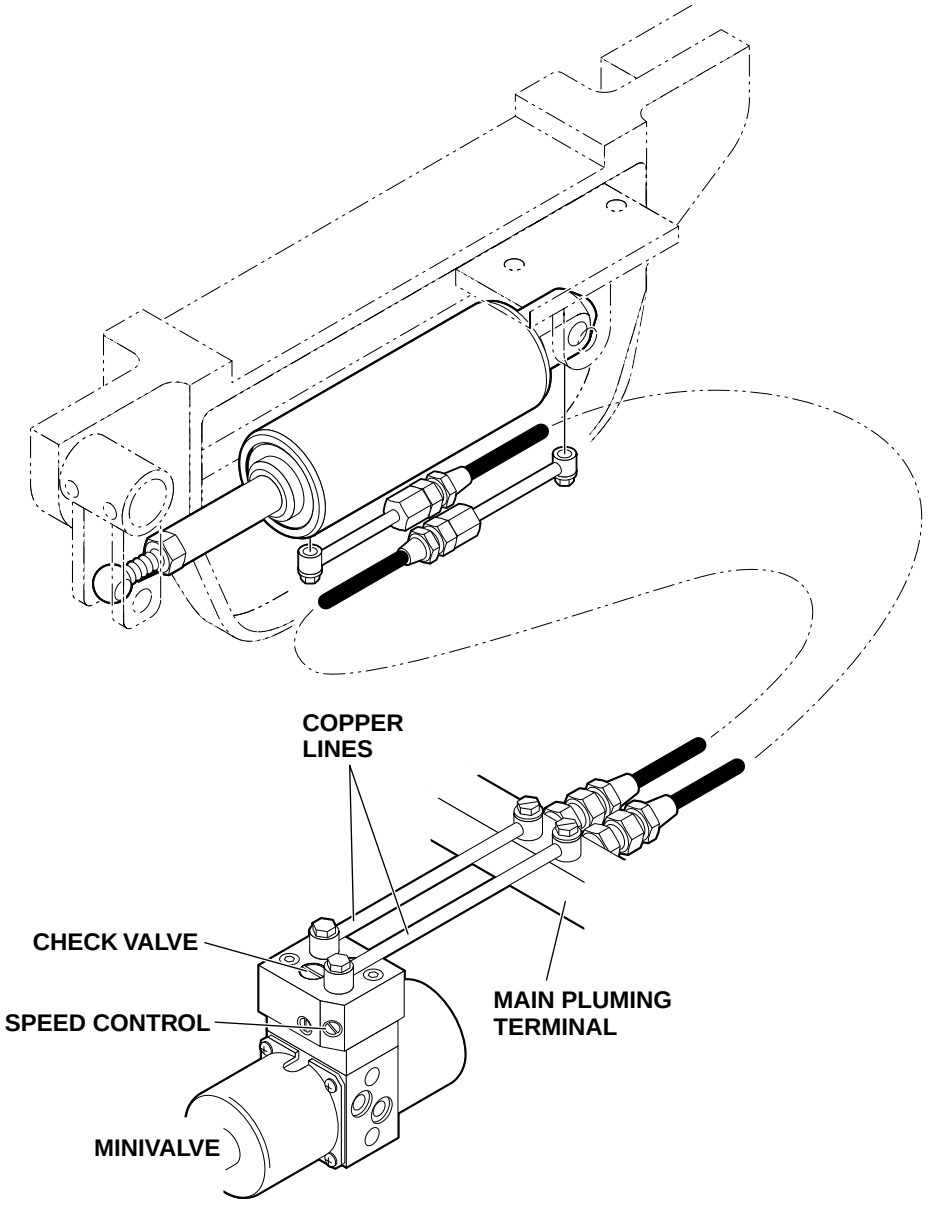


Figure 2-4. Back Section Circuit

2-7. LEG SECTION DIAGNOSIS CHART

Problem	Reason
Leg function moves improperly	Incorrect Speed Adjustment
	Spool Valve Not Centered
	Bad Check Valves
	Low on Oil
	Pinched Hose
	Defective Mini-Valve
	Pressure Relief Valve Not Set Properly
	Bad Solenoid
	Defective Relay Box or Pendant Control
Leg function chatters or loses position	Defective or Dirty Check Valves
	Oil Leakage in Circuit
	Air Inside Cylinder
	Pinched Hose
	Low on Oil

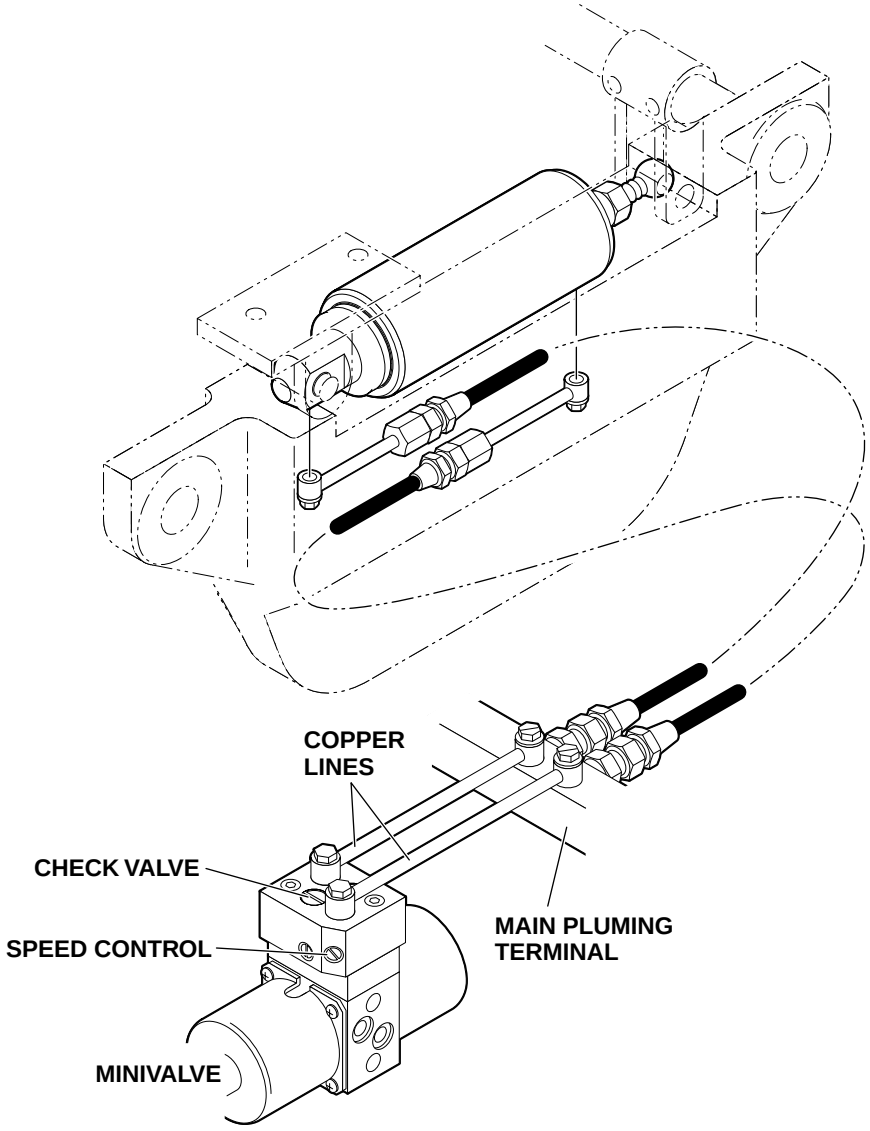


Figure 2-5. Leg Section Circuit

2-8. BRAKE CIRCUIT DIAGNOSIS CHART

Problem	Reason
Brakes will not set properly	Emergency Brake Release Valve Open or Defective Spool Valve Not Centered Bad Check Valve Low on Oil Pressure Relief Valve Not Set Properly Pinched Hose Defective Mini-Valve Defective Relay Box or Pendant Control
NOTE If brakes have been released with the Emergency Brake Release Valve, brakes will not reset until BRAKE UNLOCK Circuit has been activated.	
Brakes Will Not Stay Locked	Emergency Brake Release Valve Open or Defective Defective or Dirty Check Valve Oil Leakage in Circuit Leaking "O" Ring Inside Cylinder
Brakes will not retract properly	Incorrect Speed Adjustment Bad Check Valve Spool Valve Not Centered Defective Mini-Valve Pinched Hose Defective Solenoid or Wiring Defective Relay Box or Pendant Control

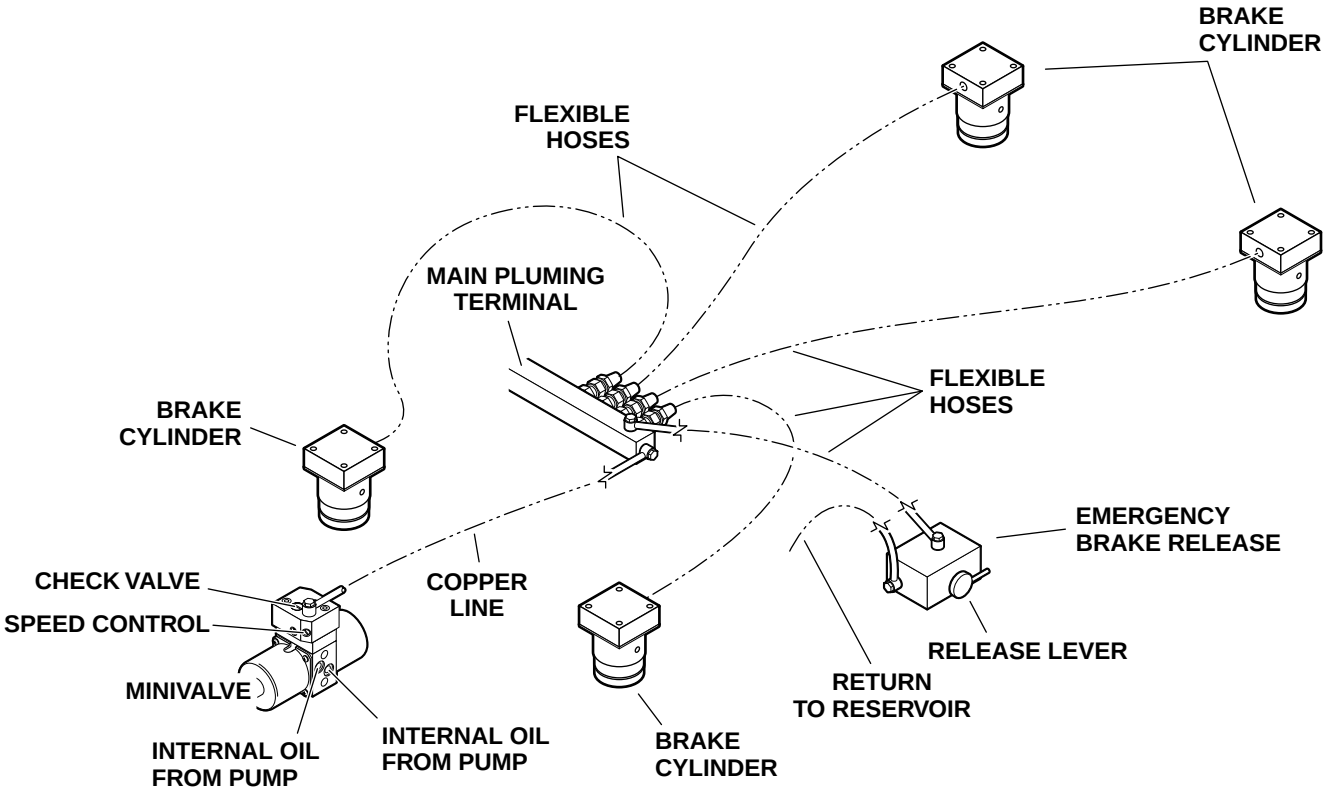


Figure 2-6. Brake System Circuit

2-9. Flexible Hose Identification and Placement

The following figure shows the correct placement of the flexible hydraulic hoses used in the table and their respective number codes.

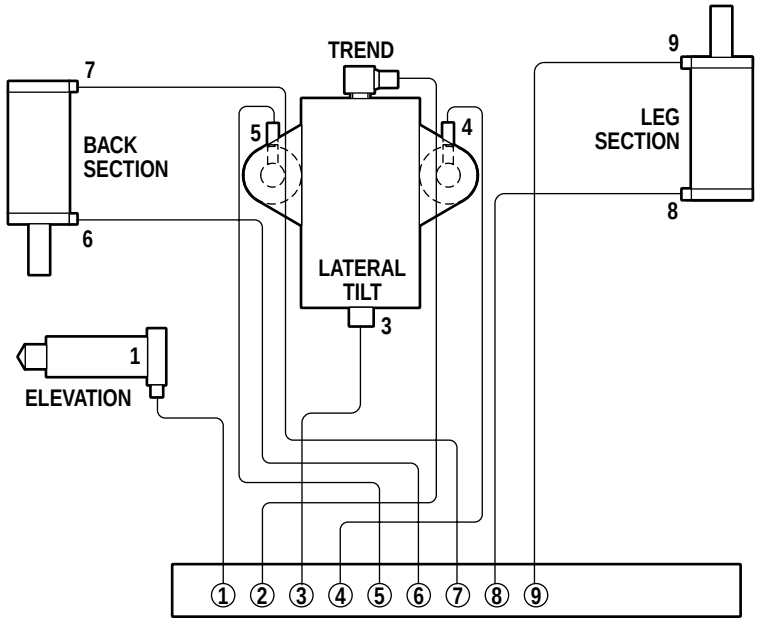


Figure 2-7. Flexible Hose Placement

SECTION III ELECTRICAL SYSTEM

3-1. General

The complete electrical system (with the exception of the hand-held pendant control) is contained within the base of the table. The pump motor and the hydraulic valves are controlled electrically with the pendant control.

The electrically operated functions are as follows:

- ELEVATION - Up and Down
- TRENDELENBURG - Head up and down
- LATERAL TILT - Right and left
- BACK SECTION - Up and Down
- LEG SECTION - Up and Down
- BRAKE UNLOCK - Brake release

The power requirements are 120 VAC, 60 Hz, fuse protected. The main power on-off switch is an enclosed DPST type and the power cord is a three-wire, fifteen foot long, UL listed cord with a three-prong hospital grade plug.

3-2. Components

Refer to figure 3-1 for the relationship of the electrical components.

a. Wires, Connectors, Switches, Fuse - These provide the path for the various electrical circuits.

b. Relay Box - Contains the step down transformer, full wave rectifier, micro-processor and relay switches. The relay switches are activated by the pendant control signal to the micro-processor and in turn energize the solenoids.

c. Hand-Held Pendant Control - Contains circuit board mounted switches and a micro-processor which activate the relay box. Operates on 5 VDC.

d. Solenoids - These electrically open and close the hydraulic ports of the mini-valve to direct the fluid to the correct cylinders. They operate on 120 VAC.

e. Motor/Pump Assembly - 120 VAC, 60 HZ, 200 Watt capacitor induction motor.

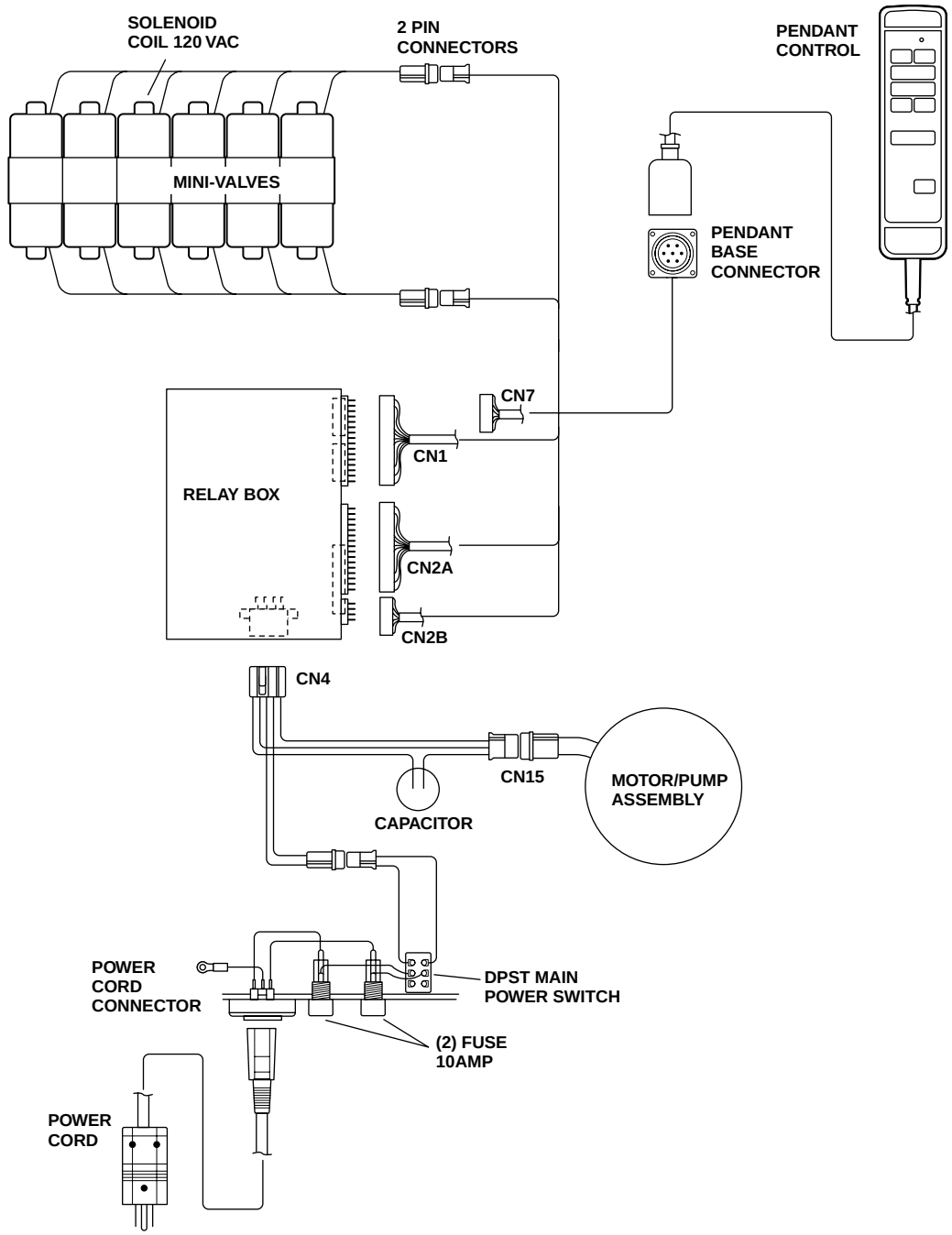


Figure 3-1. 1700 Electrical Circuit Block Diagram

4-1. Troubleshooting Notes

The basic operation of each component will be defined along with a drawing and explanation on how to check it out.

Certain defective components could cause the entire table to stop functioning or only one control function to stop. It would depend on what part of the component failed. Other defective components would only cause one control function to stop.

The following defective components could cause all control functions to be affected:

a. Motor/Pump Assembly (starting capacitor)
b. Main Switch Circuit and Wiring

The following defective components could cause all control functions to be affected or only one control function:

a. Relay Box
b. Pendant Control

The component listed below would only affect one control function:

Solenoid

When troubleshooting an electrical circuit, start at the problem and work back to the power source.

4-2. Main Switch

The main power supply, 120 VAC, 60 HZ, comes in through the power cord and through the main switch. The main switch opens both lines when in the "OFF" position. Two 10 amp fuses are used to protect the complete electrical system and are located next to the main switch.

a. Main Switch Test

The following test will determine if line voltage is applied to connector CN4, which in turn would power the table.

1. Plug the power cord into the 120VAC power supply (wall receptacle) and turn ON the main switch.

2. Disconnect connector CN4 from the relay box. See figure 4-1. Leave all other connectors connected.

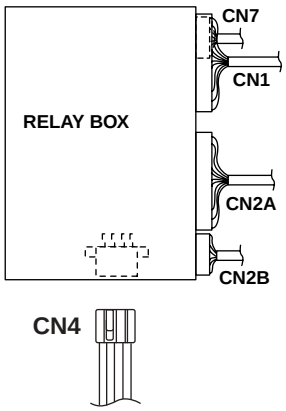
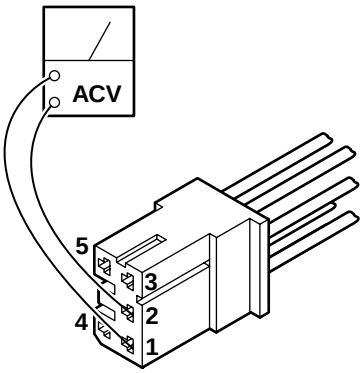


Figure 4-1. Main Power Test

CAUTION

Line voltage (120 VAC) will be measured in this test. Do not touch uninsulated connector pins or meter test leads.

3. Use an AC voltmeter capable of measuring 120 VAC and measure the voltage between pins 1 and 2 (black and white wires) located in connector CN4. See figure 4-2. You should receive line voltage 120 VAC.



PIN NO.	COLOR
1	White
2	Black
3	Red
4	Blue
5	Yellow

Figure 4-2. Connector CN4

b. Test Results

If you do not receive the correct voltage measurement, the problem would have to be in the wires, main switch, fuses, or power cord. If the correct voltage is obtained, everything is good up to this point and the problem would have to be in another area.

4-3. Pendant Control

The Pendant Control is part of the solid state, multiplex, logic control system. The pendant control contains illuminated, circuit board mounted switches and a micro processor. The encoded output from the pendant control is serial bit stream logic.

The output signal is transmitted to the micro processors in the relay box where the logic is decoded and the appropriate relays for the selected function are activated.

a. Wiring Harness Test

The following test checks the wires leading from the table connector to connector CN7 at the Relay Box. Disconnect connector CN7 from the Relay Box and using an ohmmeter, test the continuity between the corresponding pins in connectors CN7 and the table connector. See figure 4-3.

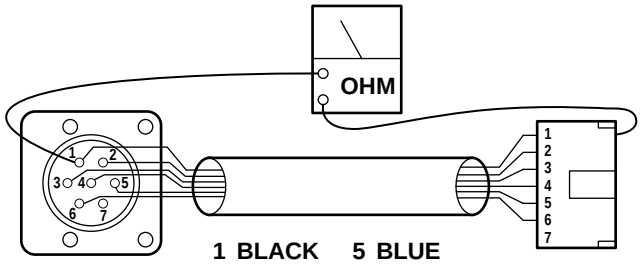


Figure 4-3. Table Base Connector

b. Test Results:

If the correct readings are obtained, this part of the circuit is okay and the problem may be the Pendant Control circuit board or the Relay Box. Contact SKYTRON if all tests performed indicate that the problem is located in the Pendant Control.

4-4. Relay Box

The 120 volt power supply is directly connected to the relay contacts. When these contacts are closed, 120 volts is supplied to the solenoids which are mounted on the hydraulic mini-valves. One relay is used to supply 120V to the pump/motor and is always activated no matter what control function is selected. The brake locking circuit relay is also activated when any control function other than BRAKE UNLOCK is *initially* selected.

Also, inside the relay box is a step-down transformer and full-wave rectifier which decreases the line voltage to 5.5 volts. This low voltage potential controls the relays by the use of the hand-held pendant control buttons. Basically the relays enable a 5.5 volt potential to control the 120 volt circuit.

The following tests will determine if the relay box is functioning correctly.

a. Checking Relay Box Connector CN4

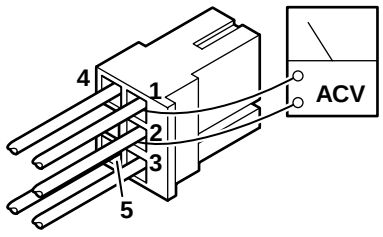
1. Connect the power cord to the table. Plug the power cord into the 120 VAC power supply (wall receptacle) and turn the main switch ON. Leave all connectors connected.

WARNING

Line voltage (120 VAC) will be measured in this test. Do not touch uninsulated connector pins or meter test leads.

2. Use an AC voltmeter capable of measuring 120 volts and measure the voltage between pins 1 (white) and 2 (black) of connector CN4 for input voltage. See figure 4-4. Meter should read line voltage 120 VAC.

3. Activate any table function with the Pendant Control and using an AC voltmeter, test the voltage at pins 3 and 4 of CN4 for output to the pump. Meter should read 120 VAC.



PIN NO.	COLOR
1	WHITE
2	BLACK
3	RED
4	BLUE
5	YELLOW

Figure 4-4. Connector CN4

b. Test Results:

If you do not receive the correct meter readings, the relay box or wiring is defective. If the correct readings are obtained, this part of the relay box is okay. Proceed to the next step.

c. Checking Output to Solenoids

his test checks the high voltage (120V) that is used to energize the solenoids.

WARNING

120 VAC will be measured in this test. Do not touch uninsulated connector pins or meter test leads.

NOTE

•The Brake Lock function is activated by pressing any function button (except BRAKE UNLOCK). A timer in the Relay Box allows continuous output for about 7 seconds. If the brakes are already locked, no output is provided.

•The BRAKE UNLOCK button activates another timer in the relay box which allows continuous output for the brake release function for approximately 7 seconds. If the brakes are released (using the BRAKE UNLOCK button) no output is provided.

1. The power cord should be plugged into the wall receptacle and Power Switch turned ON.

2. Disconnect the motor connector. All other connectors should be connected. Test connectors CN1, CN2A and CN2B from the back while attached to the relay box.

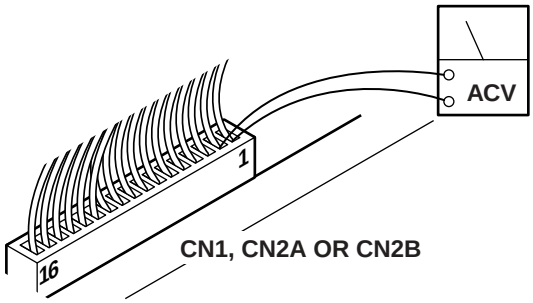
3. Activate each of the Pendant Control buttons measure the voltage for the corresponding connector pins with an AC voltmeter. See figure 4-5. Meter should read 120VAC.

d. Test Results:

If you do not receive the correct meter readings, the relay box or wiring is defective and should be replaced.

NOTE

Before deciding the relay box is defective, check the wires and pins in the connector blocks to make sure they are not loose or making a bad connection with their mate.



CN1

FUNCTION	PINS
Table Up	1 - 2
Table Down	3 - 4
Trend	5 - 6
Rev Trend	7 - 8
Tilt Right	9 - 10
Tilt Left	11 - 12
	13 - 14
	15 - 16

CN2A

FUNCTION	PINS
Back Up	1 - 2
Back Down	3 - 4
	5 - 6
	7 - 8
	9 - 10
	11 - 12
Leg Up	13 - 14
Leg Down	15 - 16

CN2B

Brake Set	1 - 2
Brake Unlock	3 - 4

Figure 4-5. Solenoid Output Connectors

e. Checking Output to Pendant Control

The output to the Pendant Control can not be tested without specialized equipment. If all tests have been conducted and it appears that the Relay Box is faulty, contact SKYTRON.

4-5. Solenoids

The solenoids are energized by 120 volt potential that is controlled by the relays located inside the relay box.

The solenoid windings are protected from excessive heat with an internal thermal fuse that will open after approximately seven (7) minutes of continuous operation. The solenoid must be replaced if the internal thermal fuse has been blown. The solenoids are mounted directly on either side of the hydraulic mini-valves and push the spool valve in one direction or the other depending upon which solenoid is activated.

a. Solenoid Test

The following tests check the voltage applied to the solenoids and the resistance of the solenoid coil.

NOTE

If a solenoid does not function when the pendant control button is pushed, the problem could be the pendant control, the relay box, or the solenoid.

NOTE

Each solenoid is controlled with 120V source coming from the relay box. This source can easily be checked by measuring the voltage at the 2 pin connector in question.

WARNING

Line voltage will be measured in this test. Do not touch uninsulated connector pins or meter test leads.

b. Step #1

1. Plug the table cord into the wall receptacle and turn main switch ON.

2. Disconnect the 2 pin connector from the solenoid in question. See figure 4-6.

3. Use a voltmeter capable of measuring 120 VAC and measure the voltage across the 2 pin connector. Polarity of meter leads is not important.

NOTE

The appropriate pendant control button must be pushed during this test. The motor will run when this test is performed, and the brake locking solenoid will be activated by any function other than UNLOCK.

c. Test Results:

If you do not receive the correct voltage, the problem could be in the wires leading to connectors. The problem could also be in the relay box or the Pendant Control (refer to appropriate section for troubleshooting).

If the correct voltage is obtained, everything is good up to that point and the problem is more than likely the solenoid.

d. Step #2

The solenoid can be checked out using an ohmmeter R x 1 scale.

1. Measure the resistance between the two pins of the connector in question. See figure 4-6. Connector being tested must be disconnected. Polarity of meter leads is not important.

2. The meter should read approximately 60 ohms at room temperature.

3. Measure the resistance between either pin and ground.

4. Meter should read infinity.

e. Test Results:

If the solenoid does not check out with the meter, it is more than likely defective and must be replaced.

NOTE

Whenever there are several components of the same type, a defective unit can also be detected by substituting a known good unit or wire connector. In some cases this may be faster than using a multi-meter.

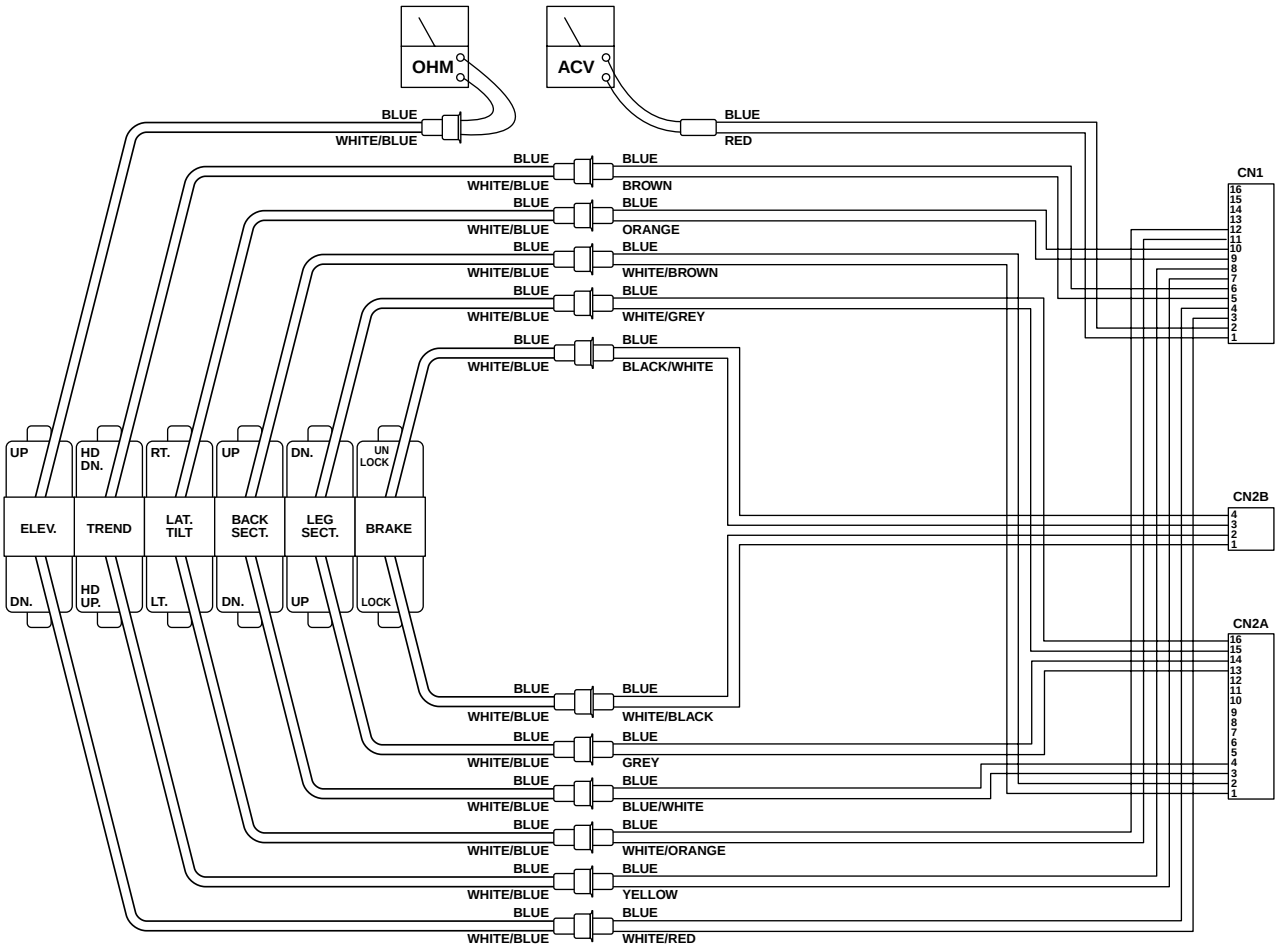


Figure 4-6. Solenoid Test

4-6. Motor/Pump Assembly

The electric motor is a capacitor start type with a rating of 120 VAC, 200 watts. The field windings are protected with a thermal protector that will open the winding circuit if the motor is run continuously for approximately 10 minutes. This protector will take about 10 minutes to automatically reset. The oil pump unit is attached to the bottom of the motor and is a gear type positive displacement pump with a pumping capacity of .4 liter per min. The Motor/ Pump Assembly is mounted on an insulated motor plate in the base of the table. The starting capacitor is mounted along side the motor/pump assembly

a. Motor/Pump Test

The following tests will check the voltage applied to the motor and the resistance of the motor field windings.

CAUTION

Line voltage will be measured in this test. Do not touch uninsulated connector pins or meter test leads.

b. Step #1

1. Plug the power cord into 120 VAC power supply (wall receptacle). Turn main switch ON.

2. Disconnect the 3 pin motor connector at the motor. Leave all other connectors connected. See figure 4-7.

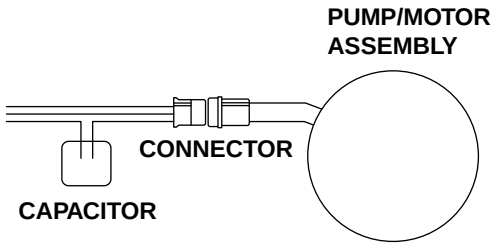
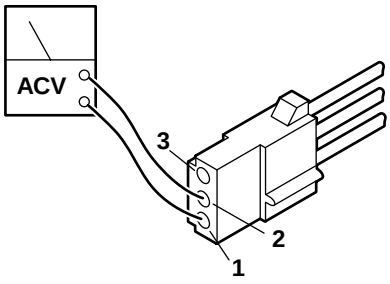


Figure 4-7.

3. Use a voltmeter capable of measuring 120 VAC and measure the following connector pins in the connector. See figure 4-8.



PIN NO	AC VOLTS
1 - 2	120
1 - 3	120
2 - 3	0

Figure 4-8. Motor Connector

c. Test Results:

If you do not receive the correct meter readings, the problem could be in the wires, connectors, relay box, or main switch (refer to appropriate section for troubleshooting).

If the correct voltage is obtained, everything is good up to that point and the problem could be either the motor or the starting capacitor.

d. Step #2

If the starting capacitor is shorted or grounded, the motor will not run. Capacitors very seldom fail, and it requires a dielectric tester to accurately test one. However, an ohmmeter can be used to determine if the capacitor will store a low voltage charge and most of the time this is adequate.

1. Turn the main switch OFF.

2. Motor connector should be disconnected.

3. Use the R x 100 scale of the ohmmeter and touch pins 2 and 3 of the connector. See figure 4-8.

e. Test Results:

The meter needle should move up scale and then back down to infinity. This would indicate that the capacitor is storing an electrical charge.

NOTE

The capacitor may have to be discharged first (by shorting pins 2 and 3 together) before you will be able to see the ohmmeter needle swing up the scale.

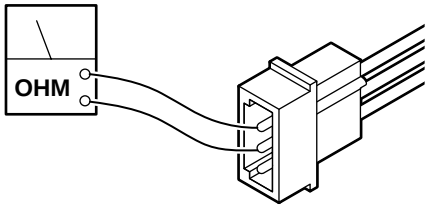
f. Step #3

The motor windings can be statically checked for resistance using an ohmmeter.

1. Turn main power switch OFF.

2. Connector CN15 should be disconnected.

3. Use the R x 1 scale of the ohmmeter and measure the resistance between the pins located in the pump connector. See figure 4-9.



PIN NO	METER
1 - 2	Approx. 5 ohms
1 - 3	Approx. 4 ohms
2 - 3	Approx. 8 ohms

Figure 4-9. Pump Connector

g. Test Results:

If you do not receive the correct meter readings, the motor or wiring is defective.

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